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DEPARTMENT OF ENERGY DECLASSIFICATION REVIEW

1ST REVIEW - DATE: 12/31/97	DETERMINATION (CIRCLE NUMBER(S))
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	7 OTHER (SPECIFY):

Health Microbots for Counter-Proliferation
and Intelligence Applications (w)

Sandia National Laboratories
Albuquerque, New Mexico

NSI

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Microbots - Miniature Intelligent Robotic Vehicles

Miniature Intelligent Robotic Vehicles (Microbots)

are mobile, intelligent, sensing platforms capable of performing such functions as: searching, following, target locating, detecting, target identification, intelligence, with stealth, miniaturization, remote control, remote transmission, and multi-agent cooperation as required.



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Micro Sensor Capabilities

- Imaging
- Seismic
- Acoustic
- Chemical
- Biological
- RF Tags
- Electromagnetic Field
- Radar
- Nuclear
- Accelerometer



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Microbot Missions - Phase I (cont'd)

- Other possible counterproliferation/intelligence applications
 - Determination of factory output (chemical, acoustic, electromagnetic, imaging, and biological sensors)
 - Location of underground structure air vents (imaging)
 - Attachment of microbot to TEL (chemical sensor, RF tags)
 - Location of high electrical power machinery (electromagnetic sensors)
 - Targeting of high value targets (imaging sensors, RF tags)
 - Locating and following communication lines (electromagnetic sensors)
 - Attachment of microbot to vehicles (RF tags, explosives)
 - Self sample collection around secure sites
 - Counter intelligence perimeter control

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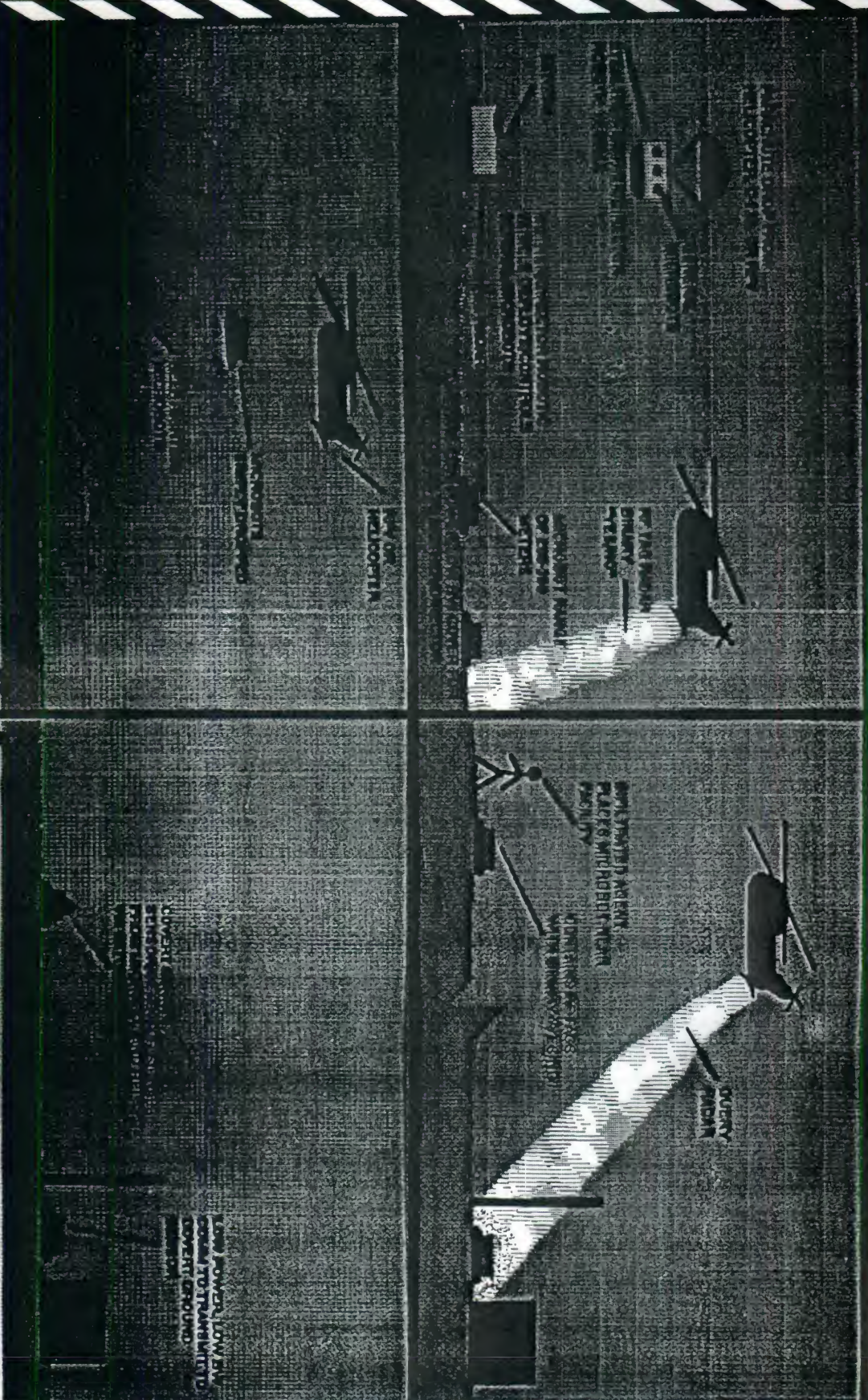
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Microbot Concept of Operations



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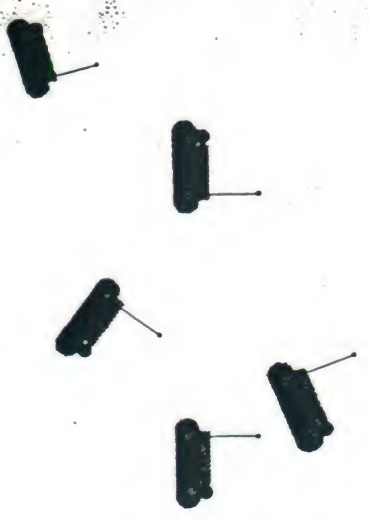
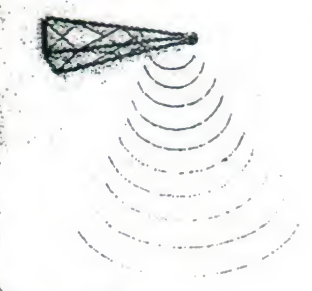
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Behavior Algorithms

Simulations and systems have been developed which demonstrate group and cooperating algorithms using genetic programming, learning classifiers, neural networks, statistical hypothesis testing, fuzzy logic, and expert systems.



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Sensor Fusion Process

Estimate Target Site Characteristics
Knowledge of Appropriate Sensor
Measurands

Risk Assessment
Sensor Data Acquisition Plan
(Sample Rate, Patterns, Filters, etc.)



Interpretation of Raw Data Using:

- Expert Systems
- Physical Models
- Statistics
- Learning Algorithms

(Neural Nets, Genetics, etc.)

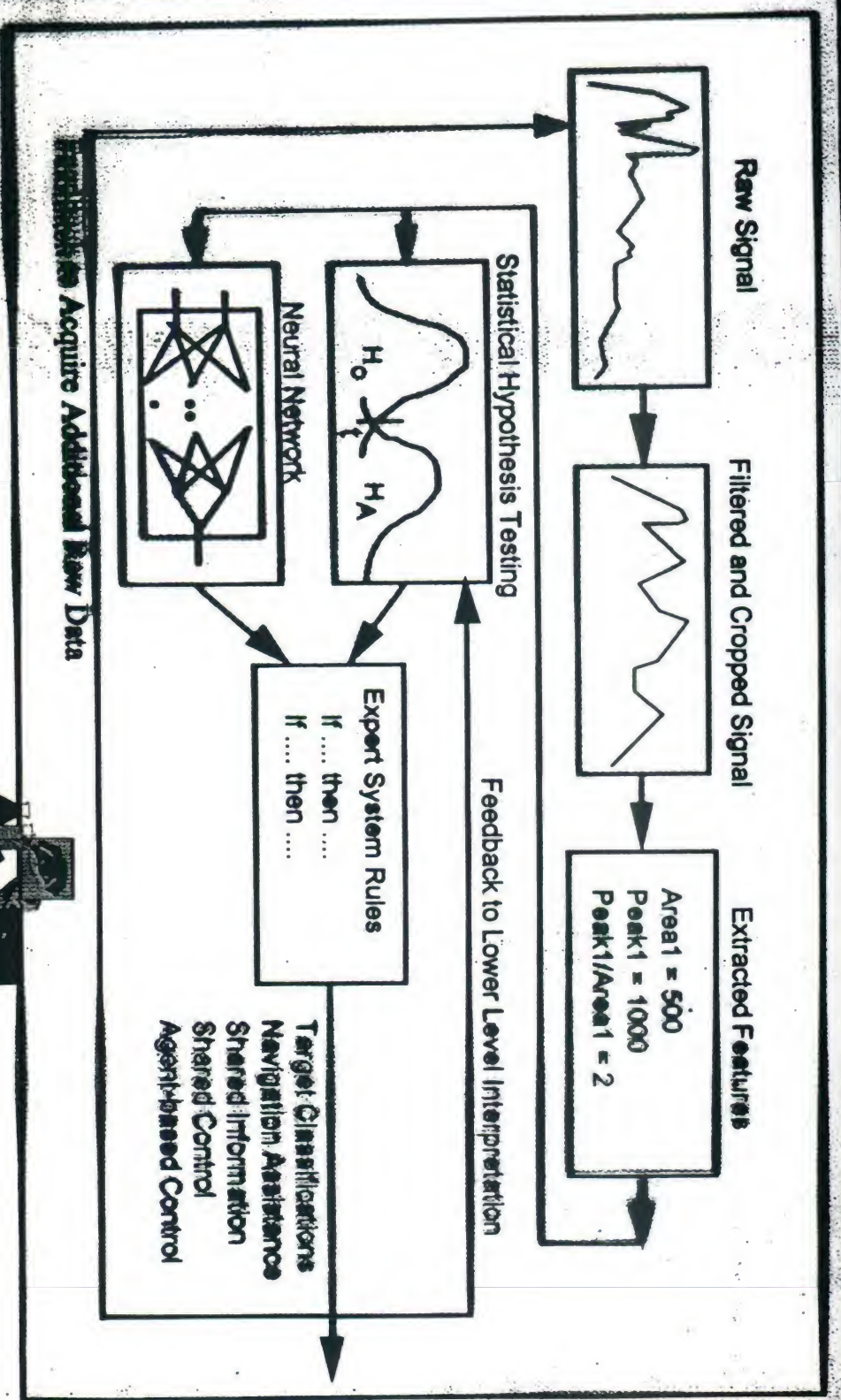
Microbot Paths/Sensing Locations
Sensor Data Acquisition Control

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Data Fusion with Statistical, Learning, and System Reasoning



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Miniature Intelligent Robotic Vehicle (MIRV)

- **Demonstrated experience in designing and building intelligent, miniature components**
 - Miniature components machine shop
 - includes EDM (Electric Discharge Machine) and miniature machining facilities
 - Experience with neural networks, fuzzy logic, and genetic algorithm control systems
- **Micromachining and microelectronics facilities**
 - complete semiconductor fabrication facility
 - LIGA micromachine fabrication facility



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Proposed Program

Objectives

- Systems study leading to architecture development which will include scenarios, concepts, design definition tradeoffs
- Development of Phase I stealthed microbots - six each of the following:
 - 6 microbots with micro, imagers with low BW communications
 - 6 microbots with micro, chemical sensors and RF tags
 - 6 microbots with micro, seismic sensors and RF tags
 - 6 microbots with electromagnetic field sensors and RF tags
 - 6 microbots with micro, nuclear sensors and RF tags
 - 6 microbots with micro, acoustic sensors with low BW communications
- Field tests of microbots
- Further development of microsensors to include:
 - Micro, biological sensors (work is proceeding at SNL but project is underfunded)
 - Micro, low BW communications
 - Micro, acoustic sensors with low BW communications
- Further development of micro fuel cells
- Research and development of Phase II microbots

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Proposed Program, cont'd.

- Cost/Schedule: Four year program at \$2M/year
 - End of first year review and microbot demonstrations
 - End of third year - sensor development complete, delivery of 36 microbots
 - End of fourth year - demonstrate operational advanced concepts

Moore